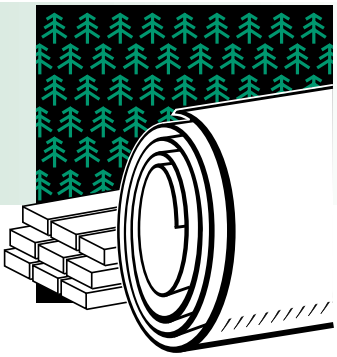
FOREST PRODUCTS

Project Fact Sheet



Development of a Field-Mobile, Near-Infrared Sensor for Measuring the Chemical Composition and Mechanical Properties of Standing Wood

Benefits

- Simplifies harvesting and thinning operations
- Allows tree selection for specific applications
- Maximizes value of forest resources
- Lowers cost of assessing wood quality and grade
- Makes available a portable sensor technology
- Decreases energy costs

Applications

This technology complements previous research conducted by NREL. It will benefit forest managers, tree breeders, and the pulp and paper and wood products industry by enhancing the choice of suitable standing trees and the quality of the final products.

A Field-Rugged System Will Be Able To Predict Properties from In-Situ Measurements

In a previous project joint-funded by DOE, researchers at the National Renewable Energy Laboratory (NREL) demonstrated an on-line monitoring system that applies advanced near infrared (NIR) technology and chemometrics to analyze the chemical composition of moving wood chips. The measurement of feedstock, chip, and pulp composition will allow pulp processors to improve tree selection processes and predict the quality of the final forestry product.

Investigators will extend this technology to develop a ruggedized, field mobile sensor for tree harvesters. The sensor will employ NIR spectroscopy and multivariate analysis techniques to quantitatively measure various characteristics of their feedstock, such as density, shrinkage, and moisture content of standing or cut trees.

Early identification and sorting of individual trees into product classes will help improve the efficiency of processing for the marketplace. A successful field sensor will also contribute to enhanced forest productivity through the proper selection of trees for breeding, thinning, and harvesting on forested lands. This integrated approach to process control will allow total quality control of wood and paper manufacturing and help minimize the production of substandard or rejected products.

Mobile Field Sensor for Wood Analysis

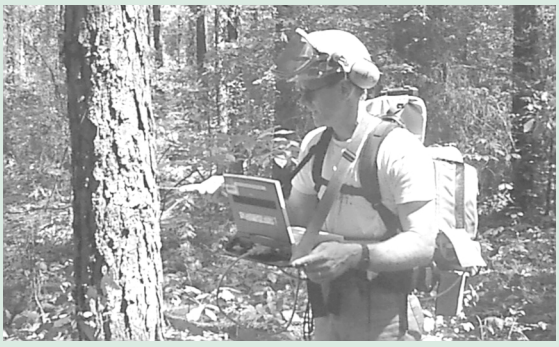


Figure 1. The researcher's backpack contains the field-mobile near infrared spectrometer. A fiber optic probe is inserted into a small core hole to acquire spectra of the standing tree.

Project Description

Goal: To develop a non-destructive, field-capable analytical sensor that can monitor growth, determine feedstock suitability, and improve product quality in forestry resources.

Researchers at NREL will use their expertise in rapid spectral analysis and information processing to develop a spectroscopic technique capable of measuring the mechanical properties of wood. The first objective will be to measure the spectral, mechanical, and anatomical properties of a large set of clear wood samples in the laboratory. Measurements will include density, shrinkage, moisture, lignin, carbohydrate, and extractive content of trees and/or logs. Multivariate analysis techniques will be used to identify correlations between the spectral fingerprint of each sample and its properties. An effective sampling technique will be determined and the effects of various wood species will be explored. The second objective will be to validate the technique in a series of field-sampling studies. Core samples will be taken from at least 200 trees; their spectral fingerprints will be measured in the field and validated in the laboratory for predicting chemical and anatomical properties.

Progress & Milestones

- An near-infrared monitoring sensor developed in a previous project, *Feedstock-to-Product Characterization Tools for the Wood and Pulp Industry*, provides the basis for continuing research. This on-line technology received an "R&D 100 Award" from *R&D magazine* in August 2000, recognizing it as one of the 100 most technologically significant new products and processes of the year.
- A field sampling protocol for the portable NIR sensor was developed to confirm the laboratory observations in field tests.
- Tests demonstrated a relationship between infrared spectra and mechanical properties on three species of wet wood and five species of dry wood.
- First year laboratory results confirmed that moisture content, specific gravity, and microfibril angle of wood can be predicted from the NIR spectra.
- Additional characterizations of anatomical properties for model development were made to test the robustness of radial core spectral acquisition.
- At the end of two-years, support will be sought from the industrial partners to conduct further field tests and proceed to commercialization.

Project Partners

National Renewable Energy Laboratory
Golden, CO

Boise Cascade Corporation
Boise, ID

The Timber Company
Seattle, WA

Weyerhaeuser Company
Tacoma, WA

U.S. Forest Service
Southern Research Station
Shreveport, LA

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